BAYOU PETITE ANSE TMDLS FOR DISSOLVED OXYGEN AND NUTRIENTS

April 19, 2002

BAYOU PETITE ANSE TMDLS
FOR DISSOLVED OXYGEN AND NUTRIENTS

SUBSEGMENT 060901

Prepared for:

US EPA Region 6
Water Quality Protection Division
Watershed Management Section

Contract No. 68-C-99-249
Work Assignment #1-67

Prepared by:

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

April 19, 2002

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources (NPS) discharging to the waterbody. This report presents TMDLs that have been developed for dissolved oxygen (DO) and nutrients for Bayou Petite Anse.

Bayou Petite Anse (subsegment 060901) is located between Delcambre, LA and New Iberia, LA in the Vermilion-Teche basin in southern Louisiana. This stream is tidally influenced due to its low gradient and proximity to the Gulf of Mexico. The predominant land use in this subsegment is agriculture. There are numerous small point source discharges in this subsegment.

Bayou Petite Anse was listed on the Modified Court Ordered 303(d) List for Louisiana as not fully supporting the designated use of propagation of fish and wildlife and was ranked as priority #1 for TMDL development. Bayou Petite Anse was not included on the 1998 303(d) List, but was later added to the list based on LDEQ assessment data collected during June through December 1998. The causes for impairment cited in the 303(d) List included organic enrichment/low DO and nutrients. The water quality standard for DO is 4 mg/L year round.

A water quality model (LA-QUAL) was set up to simulate DO, carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, and organic nitrogen. The model was calibrated using LDEQ assessment data collected during June through December 1998, data from FTN’s synoptic survey in September 2000, and other various information obtained from LDEQ and USGS. There were no intensive survey data available for Bayou Petite Anse. The projection simulation was run at critical flows and temperatures to address seasonality as required by the Clean Water Act. Reductions of existing loads from NPS were required for the projection simulation to show the DO standard of 4 mg/L being maintained. In general, the modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures Manual.

A TMDL for oxygen demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand) was calculated using the results of the projection simulation. Both implicit and explicit margins of safety were included in the TMDL calculations. The nutrient TMDL was developed based on Louisiana's water quality standard for nutrients, which states that "the naturally occurring range of nitrogen to phosphorus ratios shall be maintained". The nutrient TMDL was calculated using allowable nitrogen loadings from the projection simulation and applying a naturally occurring nitrogen to phosphorus ratio to determine the allowable phosphorus loadings.

Each TMDL for Bayou Petite Anse includes a wasteload allocation for the minor point sources with oxygen demanding dischargers within the subsegment. An overall average NPS reduction of 51% is required in the Bayou Petite Anse subsegment to meet the water quality standard for DO.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
1.0 INTRODUCTION 1-1
2.0 STUDY AREA DESCRIPTION 2-1
2.1 General Information 2-1
2.2 Water Quality Standards 2-1
2.3 Identification of Sources 2-2
2.3.1 Point Sources 2-2
2.3.2 Nonpoint Sources 2-3
2.4 Previous Data and Studies 2-3
3.0 CALIBRATION OF WATER QUALITY MODEL 3-1
3.1 Model Setup 3-1
3.2 Calibration Period 3-1
3.3 Temperature Correction of Kinetics (Data Type 4) 3-2
3.4 Hydraulics and Dispersion (Data Types 9 and 10) 3-2
3.5 Initial Conditions (Data Type 11) 3-2
3.6 Water Quality Kinetics (Data Types 12 and 13) 3-3
3.7 Nonpoint Source Loads (Data Type 19) 3-4
3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24) 3-5
3.9 Headwater and Tributary Water Quality (Data Types 21 and 25) 3-5
3.10 Point Source Inputs (Data Types 24 and 25) 3-6
3.11 Lower Boundary Condition (Data Type 27) 3-6
3.12 Model Results for Calibration 3-7
4.0 WATER QUALITY MODEL PROJECTION 4-1
4.1 Identification of Critical Conditions 4-1
4.2 Temperature Inputs 4-2
4.3 Headwater and Tributary Inputs 4-3
4.4 Point Source Inputs 4-3

TABLE OF CONTENTS (CONTINUED)

4.5 Nonpoint Source Loads 4-3
4.6 Downstream Boundary 4-4
4.7 Reaeration 4-4
4.8 Other Inputs 4-4
4.9 Model Results for Projection 4-5
5.0 TMDL CALCULATIONS 5-1
5.1 DO TMDLs 5-1
5.2 Nutrient TMDLs 5-2
5.3 Summary of NPS Reductions and Point Source Upgrades 5-3
5.4 Seasonal Variation 5-3
5.5 Margin of Safety 5-3
6.0 SENSITIVITY ANALYSES 6-1
7.0 OTHER RELEVANT INFORMATION 7-1
8.0 PUBLIC PARTICIPATION 8-1
9.0 REFERENCES 9-1

LIST OF APPENDICES

APPENDIX A: Map of the Study Area
APPENDIX B: Minor Point Source Discharges in the Study Area
APPENDIX C: Vector Diagram for Water Quality Model
APPENDIX D: LDEQ Water Quality Data and USGS Flow Data
APPENDIX E: Model Input Data and Sources for Calibration
APPENDIX F: Plots of Predicted and Observed Water Quality
APPENDIX G: Printout of Model Output for Calibration
APPENDIX H: Model Input Data and Sources for Projection
APPENDIX I: Plots of Predicted Water Quality for Projection
APPENDIX J: Printout of Model Output for Projection
APPENDIX K: TMDL Calculations
APPENDIX L: Responses to Comments

LIST OF TABLES

Table 1.1 Summary of 303(d) for Subsegment 060901 1-2

Table 2.1 Land uses in the study area based on GAP data 2-1
Table 2.2 Water quality numerical criteria and designated uses 2-2

Table 5.1 DO TMDL for Bayou Petite Anse 5-1
Table 5.2 Nutrient TMDL for Bayou Petite Anse 5-2

Table 6.1 Summary of results of sensitivity analyses 6-2

1.0 INTRODUCTION

This report presents total maximum daily loads (TMDLs) for dissolved oxygen (DO) and nutrients for Bayou Petite Anse (subsegment 060901). The subsegment was listed on the February 29, 2000 Modified Court Ordered 303(d) List for Louisiana (EPA 2000) as not fully supporting the designated use of propagation of fish and wildlife. This subsegment was not included on the 1998 303(d) List (LDEQ 1998), but was later added to the list based on LDEQ assessment data collected during June through December 1998. The suspected sources and suspected causes for impairment in the 303(d) List are included in Table 1.1. Bayou Petite Anse is ranked as priority #1 for TMDL development. The TMDLs in this report were developed in accordance with Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7. The 303(d) Listings for other pollutants in this subsegment are being addressed by EPA and the Louisiana Department of Environmental Quality (LDEQ) in other documents.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The WLA is the load allocated to point sources of the pollutant of concern, and the LA is the load that is allocated to nonpoint sources (NPS). The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and future growth.

Table 1.1. Summary of 303(d) Listing for Subsegment 060901 (EPA 2000).

Subsegment Number	Waterbody Description	Suspected Sources	Suspected Causes	Priority Ranking (1=highest)
060901	Bayou Petite Anse - Headwaters to Bayou Carlin	Minor industrial point sources Non-irrigated crop production Package plants (small flows) Petroleum activities Removal of riparian vegetation Septic tanks	Oil & Grease Suspended solids Turbidity Pesticides Nutrients Organic enrichment/low DO Pathogen indicators	1

2.0 STUDY AREA DESCRIPTION

2.1 General Information

Bayou Petite Anse is located in the Vermilion-Teche basin in southern Louisiana. It is located between the cities of Delcambre, LA and New Iberia, LA (see map in Appendix A). It runs primarily north/south and ultimately reaches the Gulf Intracoastal Waterway (GIWW). Subsegment 060901 is approximately 75 square miles in size. The land use within this watershed is predominantly agriculture (Table 2.1).

Bayou Petite Anse is a low gradient stream and is hydraulically influenced by tidal conditions through the GIWW. Values of conductivity and chloride observed in Bayou Petite Anse during the 1998 LDEQ assessment data and during the FTN 2000 surveys indicate some saltwater intrusion.

Table 2.1. Land uses in the study area based on GAP data (USGS 1998).

Land Use Type	% of Total Area
Fresh Marsh	7.2%
Saline Marsh	0.9%
Wetland Forest	4.8%
Upland Forest	3.1%
Wetland Scrub/Shrub	0.8%
Upland Scrub/Shrub	1.0%
Agriculture	64.9%
Urban	12.5%
Barren	0.0%
Water	4.7%
TOTAL	100%

2.2 Water Quality Standards

The numeric water quality standards and designated uses for Bayou Petite Anse are shown in Table 2.2. The primary numeric standard for the TMDLs presented in this report is the DO standard of 4 mg/L year round. The DO standard for Bayou Petite Anse is based on its designation as an estuarine subsegment.

Table 2.2. Water quality numerical criteria and designated uses (LDEQ 2000a).

Subsegment Number	060901
Waterbody Description	Bayou Petite Anse – Headwaters to Bayou Carlin
Designated Uses	ABC
Criteria	
Chloride	N/A
Sulfate	N/A
DO	4.0 mg/L (year round)
pH	6.5 – 9.0
Temperature	35˚C
TDS	N/A

USES: A – Primary contact recreation; B – secondary contact recreation; C – propagation of fish and wildlife; d – drinking water supply; E – oyster propagation; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

For nutrients, there are no specific numeric criteria, but there is a narrative standard that states "The naturally occurring range of nitrogen-phosphorus ratios shall be maintained… Nutrient concentrations that produce aquatic growth to the extent that it creates a public nuisance or interferes with designated water uses shall not be added to any surface waters." (LDEQ 2000a).

In addition, LDEQ issued a declaratory ruling on April 29, 1996, concerning this language and stated, "That DO directly correlates with overall nutrient impact is a well-established biological and ecological principle. Thus, when the LDEQ maintains and protects DO, the LDEQ is in effect also limiting and controlling nutrient concentrations and impacts." DO serves as the indicator for the water quality criteria and for assessment of use support. For the TMDL in this report, the nutrient loading required to maintain the DO standard is the nutrient TMDL.

2.3 Identification of Sources

2.3.1 Point Sources

A list of NPDES permits that were identified in or near the Bayou Petite Anse subsegment is included in Appendix B. These permits were identified by searching two sources of information. The primary source was a listing of all the permits in the Vermilion-Teche (basin number 06) from the LDEQ static database. The secondary source was a listing of all the permits in the Vermilion-Teche basin (hydrologic units 08080102 and 08080103) from EPA's Permit Compliance System (PCS) on the EPA website. All of the information concerning permit parameters and design flow in Appendix B was obtained by manually retrieving hard copies of the permit files from LDEQ's file room.

Facilities without oxygen demanding parameters in their permit were assumed to exert a negligible oxygen demand in the receiving stream; therefore, these facilities were excluded from any further consideration in this TMDL. All of the facilities with oxygen demanding parameters in their permit were included in the TMDL calculations, but none of them was considered large enough to be modeled explicitly. The remaining oxygen demanding discharges were included in the TMDL by adding their oxygen demand to the total loading simulated in the model.

2.3.2 Nonpoint Sources

Several NPS were cited as suspected causes of impairment for Bayou Petite Anse in the 303(d) List. These NPS include non-irrigated crop production, petroleum activities, removal of riparian vegetation, and septic tanks (Table 1.1).

2.4 Previous Data and Studies

Listed below are previous water quality data and studies for Bayou Petite Anse or adjacent waterbodies.

1. Data collected by LDEQ for "Bayou Petite Anse" (station 0681) for mid-June to December 1998. This station is located at Lee Station Road and Highway 14, 4 miles east of Delcambre, LA and 4 miles north of Avery Island, LA.
2. Data collected by LDEQ for "Gulf Intracoastal Waterway (GIWW)" (station 0694) for mid-June to December 1998. This station is located one mile southeast of confluence of Bayou Petite Anse and GIWW, 11 miles southeast of Abbeville, LA and 13 miles southwest of New Iberia, LA.
3. Data collected by FTN for "Bayou Petite Anse" (stations 0681-1 and 0681-2) on September 20, 2000. Station 0681-1 is at the same location as LDEQ Station 0681. Station 0681-2 is located on Hayes Road, approximately 1-1/2 miles north of Avery Island, LA.

4. Data collected by FTN for "Segura Branch Canal" (station 0681-3) on September 20, 2000. Station 0681-3 is located on Highway 3013 near Highway 90, approximately 2 miles upstream of Bayou Petite Anse.
5. Data collected by FTN for "Armenco Branch Canal" (station 0681-4) on September 19, 2000. Station 0681-4 is located at Highways 675 and 90, approximately 4 miles upstream of Bayou Petite Anse.

3.0 CALIBRATION OF WATER QUALITY MODEL

3.1 Model Setup

In order to evaluate the linkage between pollutant sources and water quality, a computer simulation model was used. The model used for these TMDLs was LA-QUAL (version 3.02), which was selected because it includes the relevant physical, chemical, and biological processes and it has been used successfully in the past for other TMDLs in Louisiana. The LA-QUAL model was set up to simulate organic nitrogen, ammonia nitrogen, ultimate carbonaceous biochemical oxygen demand (CBODu), and DO. Phosphorus and algae were not simulated because algae do not appear to have significant impacts on DO in this subsegment.

The model starts at the confluence of Bayou Parc Perdu and Segura Branch Canal, which is the upstream end of Bayou Petite Anse. The model extends approximately 17 km downstream to the confluence of Bayou Petite Anse and Bayou Carlin, which is the downstream boundary of subsegment 060901. The model was divided into 6 reaches to represent different widths and depths along the length of the stream. The reach lengths vary from 1.5 km to 3.2 km. The inflows to the model are the headwater inflow, Deblanc Coulee, and Armenco Branch Canal. The locations of the modeled inflows and the reach design are shown on the vector diagram in Appendix C.

3.2 Calibration Period

The two data sets that were considered for model calibration were the LDEQ 1998 assessment data and the FTN 2000 synoptic survey data. The LDEQ data were collected at only 1 station during June through September 1998, while the FTN data were collected at 4 stations on September 19 and 20, 2000 (station locations are shown on map in Appendix A). Because the FTN data were collected at multiple stations, the model was calibrated to September 2000 conditions. Both the LDEQ and FTN data are shown in Appendix D.

The calibration target (i.e., the concentrations to which the model was calibrated) for each parameter for each station was set to the measured concentration during the calibration period.

3.3 Temperature Correction of Kinetics (Data Type 4)

The temperature correction factors used in the model were consistent with the Louisiana Technical Procedures Manual (the "LTP"; LDEQ 2000b). These correction factors were:

- Correction for BOD decay: 1.047 (value in LTP is same as model default)
- Correction for SOD: 1.065 (value in LTP is same as model default)
- Correction for ammonia N decay: 1.070 (specified in Data Group 4)
- Correction for organic N decay: 1.020 (not specified in LTP; model default used)
- Correction for reaeration: automatically calculated by the model

3.4 Hydraulics and Dispersion (Data Types 9 and 10)

The stream hydraulics were specified in the input for the LA-QUAL model using the power functions (width = a * Q^b + c and depth = d * Q^e + f). Under low flow conditions, the depths and widths for each reach in the model can be assumed to be independent of flow rate. Therefore, the system was modeled with constant depth and width. This was specified in the model by setting the coefficients and exponents as follows (the values for each reach are shown in Appendix E):

- width coefficient (a) = 0.0
- width exponent (b) = 0.0
- width constant (c) = typical width of reach
- depth coefficient (D) = 0.0
- depth exponent (e) = 0.0
- depth constant (f) = typical depth of reach

Widths were estimated from measured data, digital ortho quarter quads (DOQQ), and topographic maps (see Appendix E). Depths were estimated from measured data or calculated based on depth to width ratios from measured stations.

3.5 Initial Conditions (Data Type 11)

The primary parameter that is specified in the initial conditions for LA-QUAL is the temperature for each reach (because temperature was not being simulated). The input values for initial conditions were set to the measured value at the appropriate FTN station during the calibration period. The input data and sources are shown in Appendix E.

One other parameter that was specified in the initial conditions was the salinity. Salinity was not simulated in the model (i.e. it was not "turned on" in Data Group 2), but a salinity value was entered as an initial condition so the model would use that value in the calculations for DO saturation. Because salinity data were not included in the monitoring data for this subsegment, a salinity value was estimated using the conductivity measurements from the calibration period and using a conversion between conductivity and salinity (equation 3-9b in EPA 1985). The estimated salinity at the appropriate FTN station was applied. The input data and sources are shown in Appendix E.

For other constituents not being simulated, the initial concentrations were set to zero; otherwise, the model would have assumed a fixed concentration of those constituents and the model would have included the effects of the unmodeled constituents on the modeled constituents (e.g., the effects of algae on DO).

3.6 Water Quality Kinetics (Data Types 12 and 13)

Kinetic rates used in LA-QUAL include reaeration rates, SOD, carbonaceous biochemical oxygen demand (CBOD) decay rates, nitrification rates, and mineralization rates (organic nitrogen decay). The values used in the model input are shown in Appendix E.

Reaeration was specified in the lower reaches of the Bayou Petite Anse model using a surface transfer coefficient. Because the lower reaches (Reaches 3 through 6) were wide, the effect of wind on reaeration was included. A wind-aided surface transfer coefficient was calculated using measured wind speeds from New Orleans, LA and Lake Charles, LA. The daily wind speed was obtained for the calibration period, corrected to a height of 0.1 m, and then used to calculate a wind-aided surface transfer coefficient of 1.06 m/day. Because the upper reaches of Bayou Petite Anse were relatively narrow (less than 30 meters), it was assumed that wind would not significantly increase reaeration in these reaches. For reaeration in reaches 1 and 2 the Louisiana equation (option 15) was used.

The SOD rates were developed through iteration in the calibration. The SOD rate for each reach of Bayou Petite Anse was adjusted so that predicted DO concentrations were similar to the calibration target values. The CBOD decay rate was set to 0.10/day based on LDEQ's guidance for uncalibrated modeling of the Mermentau and Vermilion-Teche basins (LDEQ 2000c) and information in the "Rates, Constants, and Kinetics" publication (EPA 1985).

The mineralization rate (organic nitrogen decay) in the model was set to 0.05/day for all reaches. This value was based on information in "Rates, Constants, and Kinetics" publication (EPA 1985). Nitrification rates were set to 0.10/day for all reaches, which is consistent with guidance in the LTP based on stream depth.

One other input value was specified for characterizing the nitrification process. In the program constants section of the model input file (data type 3), the nitrification inhibition option was set to 1 instead of the default of option number 2. With the default option, the nitrification rate drops rapidly when the DO drops below 2 mg/L, which results in an unrealistic build up of ammonia nitrogen at low DO values. Option number 1 provides nitrification inhibition that is similar to what is used in other water quality models such as QUAL2E and WASP (FTN 2000a).

3.7 Nonpoint Source Loads (Data Type 19)

The NPS loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, benthic ammonia source rates, CBODu loads, and organic nitrogen loads. The SOD (specified in data type 12), the benthic ammonia source rates (specified in data type 13), and the mass loads of organic nitrogen and CBODu (specified in data type 19) were all treated as calibration parameters; their values were adjusted until the model output was similar to the calibration target values. The values used as model input are shown in Appendix E.

These four calibration parameters were adjusted in a specific order based on the interactions between state variables in the model. First, the organic nitrogen loads were adjusted until the predicted organic nitrogen concentrations were similar to the observed concentrations. Organic nitrogen was calibrated first because none of the other state variables affect the organic nitrogen concentrations. Next, the benthic ammonia source rates were adjusted until the predicted ammonia nitrogen concentrations were similar to the observed concentrations. Then the CBODu loads were adjusted until the predicted CBODu concentrations were similar to the observed concentrations. Finally, the SOD rates were adjusted until the predicted DO concentrations were similar to the observed concentrations. The DO was calibrated last because all of the other state variables affect DO.

3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24)

The inflows to Bayou Petite Anse were calculated using the published drainage area of Bayou Parc Perdu of 34.85 square miles (USGS 1971). A flow per square mile was developed using the average daily flow data during the calibration period at USGS gaging station 08010000, Bayou des Cannes at Eunice, LA. The Bayou des Cannes watershed was selected because it has similar land use as Bayou Petite Anse. The value (0.0017 cfs/sq mi) was applied to the Bayou Petite Anse headwater drainage area to calculate the inflow of 0.0585 cfs or 0.0017 m^3/sec. Additional tributary flow was estimated using the same formula and applied in the model as inflows form Deblanc Coulee and Armenco Branch Canal. For Deblanc Coulee, a drainage area of 11.7 square miles was estimated from USGS quadrangle maps (which includes the Segura Branch Canal), with a resulting inflow of 0.020 cfs or 0.0006 m^3/sec. The Armenco Branch Canal drainage area of 9.0 square miles was a published value, (USGS 1971) and the estimated inflow was equal to 0.015 cfs or 0.0004 m^3/sec. Daily flow data for the calibration period are listed in Appendix D and values used as model input are shown in Appendix E.

3.9 Headwater and Tributary Water Quality (Data Types 21 and 25)

The temperature used in the headwater inflow was the temperature measured for the calibration period at the FTN station 0681-3 for Segura Branch Canal, which is located at the headwaters of Bayou Petite Anse. Concentrations of DO and ammonia nitrogen were measured on Segura Branch Canal and specified in the model for the headwater inflow. $CBOD_5$ was also measured, but the resulting value was below the detection level of 2 mg/L; therefore the concentration was assumed to be half of the detection limit. The $CBOD_5$ concentration was multiplied by 4.5 to convert to CBODu in the model for headwater inflow. The value of 4.5 was the median ratio of CBODu to $CBOD_5$ from LDEQ's long term BOD analyses during 2000. Also, organic nitrogen was determined as total Kjeldahl nitrogen (TKN) minus ammonia nitrogen.

For Deblanc Coulee, the temperature was set to the value measured at FTN station 681-3, Segura Branch Canal, which is located just north of Deblanc Coulee. The flow value used is described above in section 3.8. Concentrations of salinity, DO, CBODu, organic nitrogen, ammonia nitrogen, and nitrite+nitrate specified in the model were based on average concentrations from eight stations sampled by FTN during the 2000 synoptic survey. These eight stations represented flow from agricultural areas similar to the Bayou Petite Anse watershed.

For Armenco Branch Canal, the temperature was set to the value measured at FTN station 681-4 which is located on the canal. The flow value used was estimated as described above in section 3.8. Concentrations of salinity, DO, ammonia nitrogen, and nitrite+nitrate specified in the model were measured at station 681-4 during the calibration period. The measured $CBOD_5$ value was below the detection level; therefore CBODu was estimated at half of the detection level and then multiplied by 4.5 to convert to CBODu. The organic nitrogen was determined as TKN minus ammonia nitrogen.

The values used as model input are shown in Appendix E.

3.10 Point Source Inputs (Data Types 24 and 25)

No point sources discharges were modeled explicitly in the Bayou Petite Anse model.

3.11 Lower Boundary Condition (Data Type 27)

Because longitudinal dispersion was explicitly specified in data type 10, the model required input values for downstream boundary conditions. The downstream end of the model is approximately 2 ½ miles from the confluence with the GIWW. Observed data for the GIWW (LDEQ station 0684) were not available during the calibration period, but were available during June through December 1998. By comparing the 1998 data at the LDEQ stations on Bayou Petite Anse and GIWW, a relationship between the data was developed and then applied to the GIWW data.

The LDEQ reference stream data included DO, total organic carbon (TOC), and total Kjeldahl nitrogen (TKN), but not CBOD or ammonia nitrogen. Therefore, CBODu was estimated from TOC and ammonia nitrogen was estimated from TKN. Relationships between these parameters were developed using data from the FTN synoptic survey in September 2000 and data from LDEQ's long term BOD analyses during 2000. The median ration of TOC to $CBOD_5$ from the FTN synoptic survey data was 6.0 and the median ratio of CBODu to $CBOD_5$ from the LDEQ long term BOD data was 4.5. Combining these ratios yielded the following relationship that was used to develop model inputs:

CBODu = 0.75 * TOC

Also, the median ratio of ammonia nitrogen to TKN form the FTN synoptic survey data was 0.17. This value was similar to the median ratio of ammonia nitrogen to TKN form the LDEQ data. The organic nitrogen was then determined as TKN minus ammonia nitrogen. This yielded the following relationships that were used to develop model inputs:

Ammonia nitrogen = 0.17 * TKN
Organic nitrogen = 0.83 * TKN

3.12 Model Results for Calibration

Plots of predicted and observed water quality for the calibration are presented in Appendix F and a printout of the LA-QUAL output file is included as Appendix G. The calibration was considered to be acceptable based on the amount of data that were available.

4.0 WATER QUALITY MODEL PROJECTION

EPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Therefore, the calibrated model was used to project water quality for critical conditions. The identification of critical conditions and the model input data used for critical conditions are discussed below.

4.1 Identification of Critical Conditions

Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7 both require the consideration of seasonal variation of conditions affecting the constituent of concern and the inclusion of a MOS in the development of a TMDL. For the TMDLs in this report, analyses of LDEQ long-term ambient data were used to determine critical seasonal conditions. A combination of implicit and explicit MOS was used in developing the projection model.

Critical conditions for DO have been determined for the Vermilion-Teche basin in previous TMDL studies. The analyses concluded that the critical conditions for stream DO concentrations occur during periods with negligible nonpoint runoff, low stream flow, and high stream temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow and the stream temperature is lowered by the cooler precipitation and runoff. In addition, runoff coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. DO saturation values are, of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and DO but not necessarily periods of high BOD decay.

LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the stream, which is, in turn, expressed as SOD and/or resuspended BOD in the model. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow.

According to the LTP, critical summer conditions in DO TMDL projection modeling are simulated by using the annual 7Q10 flow or 0.1 cfs, whichever is higher, for all headwaters, and 90th percentile temperature for the summer season. Model loading is from point sources, perennial tributaries, SOD, and resuspension of sediments. In addition, all point sources are assumed to be discharging at design capacity.

In reality, the highest temperatures occur in July-August, the lowest stream flows occur in October-November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The combination of these conditions plus the impact of other conservative assumptions regarding rates and loadings yields an implicit MOS that is not quantified. Over and above this implicit MOS, an explicit MOS of 20% for point sources and 10% for NPS was incorporated into the TMDLs in this report to account for future growth and model uncertainty.

4.2 Temperature Inputs

The LTP (LDEQ 2000b) specified that the critical temperature should be determined by calculating the 90th percentile seasonal temperature for the waterbody being modeled. Because the LDEQ station in the study area had only 6 months of data, LDEQ data from nearby areas were used for this analysis. Long term temperature data from Delcambre Canal east of Abbeville, LA (LDEQ station 0315) were used to calculate a 90th percentile summer temperature of 31.0 C. However, the water temperatures for Delcambre Canal during June through December 1998 were slightly warmer than the temperatures in Bayou Petite Anse during that time. Therefore, the critical temperature for Bayou Petite Anse was estimated as the 90th percentile summer temperature for Delcambre Canal (31.0˚C) minus the average temperature difference (0.8˚C) during June through December 1998 between the Delcambre Canal and Bayou Petite Anse stations. The resulting value of 30.2˚C was specified in data type 11 in the model input and is shown in Appendix H.

Because the Bayou Petite Anse subsegment has a year round standard for DO, a winter projection simulation was not performed. As discussed above, the most critical time of year for meeting a constant DO standard is the period of high temperatures and low flows (i.e., summer).

4.3 Headwater and Tributary Inputs

There are no USGS flow gages and no published 7Q10 flows for Bayou Petite Anse. However, published 7Q10 values were available for the USGS gages for Bayou Bourbeau at Shuteston (07386500) and Bayou Carencro at Sunset (07386000). Both of these gages are in the Vermilion River basin and have small drainage areas where most of the flow is natural runoff rather than water that has been diverted from another basin. The published 7Q10 flows are zero for both of these gages (USGS 1980). Because the drainage areas for these gages (19 mi^2 for Bayou Bourbeau and 37 mi^2 for Bayou Carencro) are similar to the drainage ares for the headwater and tributary inflows for Bayou Petite Anse (ranging from 9 to 35 mi^2), the 7Q10 flow for each headwater and tributary was assumed to be zero. The LTP specifies that the critical flow rates for summer should be set to the 7Q10 flow or 0.1 cfs, whichever is smaller. Therefore, the flow rate for each headwater and tributary in the projection simulation was set to 0.1 cfs (0.003 m^3/sec).

For the water quality for the headwater and tributaries, the DO was set to 90% saturation at the critical temperature (following guidance in the LTP). Concentrations for other water quality parameters were kept the same as in the calibration. The values used as model input in the projection simulation are shown in Appendix H.

4.4 Point Source Inputs

No major point source discharges were explicitly included in this model.

4.5 Nonpoint Source Loads

Because the initial projection simulation was showing low DO values, the NPS loadings were reduced until the predicted DO values were equal to or greater than the water quality standard of 4.0 mg/L. Within each reach, the same percent reduction was applied to all components of the NPS loads (SOD, benthic ammonia source rates, and mass loads of CBODu and organic nitrogen). The values used as model input in the projection simulation are shown in Appendix H.

4.6 Downstream Boundary

For the projection simulation, the downstream boundary condition for temperature was set to the same as the critical temperature for Bayou Petite Anse. This was done so that the model would not change the temperature in Bayou Petite Anse. For DO, the downstream boundary was set to 4.0 mg/L, which is the water quality standard for Bayou Petite Anse and for the downstream subsegment. Concentrations for other parameters were the same as in the calibration model. The values used as model input in the projection simulation area shown in Appendix H.

4.7 Reaeration

Reaeration for the projection simulation was calculated based on long-term average wind speed (as opposed to using wind speed for specific days for the calibration). The long-term average wind speeds for the months of May through October at New Orleans and Lake Charles (the same stations used for the calibration) were used to calculate a wind-aided reaeration coefficient in the same manner as in the calibration. The months of May through October represent the summer months, or critical months, per the LTP. The values used as model input in the projection simulation are shown in Appendix H.

4.8 Other Inputs

The only model inputs that were changed from the calibration to the projection simulation were the inputs discussed above in Sections 4.2 – 4.7. All of the other model inputs (e.g., hydraulic and dispersion coefficients, decay rates, etc.) were unchanged from the calibration simulation.

4.9 Model Results for Projection

Plots of predicted water quality for the projection are presented in Appendix I and a printout of the LA-QUAL output file is included as Appendix J.

For reaches 1, 2, 3, and 5 of Bayou Petite Anse, NPS load reductions of 40% were required to bring the predicted DO values to at least 4.0 mg/L. Reach 4, which included the greatest NPS loading, required a reduction of 10% to bring the predicted DO values to at least 4.0 mg/L. In reach 6, the downstream most reach, NPS reductions of 70% were required to achieve a predicted DO value of at least 4.0 mg/L. The overall NPS load reduction for the subsegment is 51%. Reduction of NPS loads was necessary because there are no point source loads that have an effect on the predicted DO.

The percentage reductions for NPS loads mentioned above represent percentages of the entire NPS loading, not percentages of the manmade NPS loading. The NPS loads in this report were not divided between natural and manmade because it would be difficult to estimate natural NPS loads for Bayou Petite Anse.

5.0 TMDL CALCULATIONS

5.1 DO TMDLs

A total maximum daily load (TMDL) for DO has been calculated for Bayou Petite Anse based on the results of the projection simulation. The DO TMDL is presented as oxygen demand from CBODu, organic nitrogen, ammonia nitrogen, and SOD. A summary of the loads is presented in Table 5.1. TMDL calculations are included in Appendix K.

Table 5.1. DO TMDL for Bayou Petite Anse.

	Oxygen demand (kg/day) from:				Total oxygen demand (kg/day)
Source of Oxygen Demand	**CBODu**	**Organic N**	**Ammonia N**	**SOD**	
WLA for minor point sources	150	0	116	N/A	266
MOS for point sources	38	0	29	N/A	67
LA for NPS	713	113	1	888	1715
MOS for NPS	79	13	0.1	99	191
Total maximum daily load	980	126	146	987	2239

The oxygen demand from organic nitrogen and ammonia nitrogen loads was calculated as 4.33 times the nitrogen loads (assuming that all organic nitrogen is eventually converted to ammonia). The value of 4.33 is the same ratio of oxygen demand to nitrogen that is used by the LA-QUAL model. For the SOD loads, a temperature correction factor was included in the calculations (in order to be consistent with LDEQ procedures).

The WLA for minor point sources represents the loads from small oxygen demanding discharges that were not explicitly modeled. This WLA was based on current permit limits with no reductions. For discharges with no permit limits for ammonia nitrogen, the effluent concentrations for ammonia nitrogen were assumed based on the BOD_5 permit limits and typical combinations of BOD_5 and ammonia nitrogen listed in the LTP (LDEQ 2000b).

Because the WLAs for minor point sources represented loads from small oxygen demanding discharges that were not simulated in the model, these loads were added to the modeled loads for the TMDL. The MOS for minor point sources was set to 20% of the total minor point source loading. The load allocations for NPS were calculated as 90% of the NPS load simulated in the model. The other 10% of the NPS load simulated in the model was designated as an explicit MOS.

5.2 Nutrient TMDLs

Because Bayou Petite Anse was on the 303(d) List for nutrients as well as DO (see Table 1.1), a nutrient TMDL was also developed. As discussed in Section 2.2, Louisiana has no numeric standards for nutrients, but has a narrative standard that states that "the naturally occurring range of nitrogen-phosphorus ratios shall be maintained" (LDEQ 2000a). For this TMDL, nutrients were defined as total inorganic nitrogen (ammonia nitrogen plus nitrate/nitrite nitrogen) and total phosphorus. The value used for the naturally occurring nitrogen to phosphorus ratio was 1.96, which was the median ratio of total inorganic nitrogen to total phosphorus from historical data that was analyzed for a previous nutrient TMDL for the Lake Fausse Pointe/Dauterive Lake system (FTN 2000a).

The first step in calculating the nutrient TMDL was to determine the loads of total inorganic nitrogen (TIN) that were simulated in the projection model. The loads in the projection model represent the maximum allowable loads that will maintain DO standards. Then the allowable loads of total phosphorus (TP) were calculated by dividing the nitrogen loads by the naturally occurring ratio of TIN to TP (which was 1.96 as discussed above). The resulting loads of TIN and TP for the subsegment are presented in Table 5.2.

Table 5.2. Nutrient TMDL for Bayou Petite Anse.

Source of Nutrients	Ammonia-N (kg/d)	NO2+NO3-N (kg/d)	Inorganic-N (kg/d)	Total P (kg/d)
WLA for minor point sources	26.80	24.42	51.22	26.18
MOS for Point Sources	6.70	6.11	12.81	6.55
LA for Nonpoint Sources	0.23	0.25	0.48	0.25
MOS for Nonpoint sources	0.03	0.03	0.06	0.03
Total Maximum Daily Load	33.76	30.81	64.57	33.01

5.3 Summary of NPS Reductions and Point Source Upgrades

In summary, the projection modeling used to develop the TMDLs above showed that overall NPS loads need to be reduced 51% to achieve the DO standard in Bayou Petite Anse. No point source upgrades are recommended because there are no point source discharges that have any significant impact on DO in Bayou Petite Anse.

5.4 Seasonal Variation

As discussed in Section 4.1, critical conditions for DO in Louisiana waterbodies have been determined to be when there is negligible nonpoint runoff and low stream flow combined with high water temperatures. In addition, the models account for loadings that occur at higher flows by modeling sediment oxygen demand. Oxygen demanding pollutants that enter the waterbodies during higher flows settle to the bottom and then exert the greatest oxygen demand during the high temperature seasons.

5.5 Margin of Safety

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. As discussed in Section 4.1, the highest temperatures occur in July through August, the lowest stream flows occur in October through November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implicit MOS that is not quantified. In addition to the implicit MOS, the TMDLs in this report included explicit margins of safety of 20% for point source loads and 10% for NPS loads.

6.0 SENSITIVITY ANALYSES

All modeling studies necessarily involve uncertainty and some degree of approximation. It is therefore of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The sensitivity analyses were performed by allowing the LA-QUAL model to vary one input parameter at a time while holding all other parameters to their original value. The projection simulation was used as the baseline for the sensitivity analysis. The percent change of the model's minimum DO projections to each parameter is presented in Table 6.1. Each parameter was varied by ±30%, except for temperature, which was varied ±2ºC.

Values reported in Table 6.1 are sorted by percentage variation of minimum DO from smallest percentage variation to largest. Reaeration was the parameter to which DO was most sensitive (15% to 28%). The model results were slightly sensitive to velocity, depth, SOD, initial temperature, and BOD decay rate with variations in predicted DO ranging from 2% to 9%. The model was not sensitive to headwater flow or dispersion.

Table 6.1. Summary of results of sensitivity analyses.

Input Parameter	Parameter Change	Predicted minimum DO (mg/L)	Percent Change in Predicted DO (%)
Baseline	-	4.21	N/A
Dispersion	+30%	4.21	<1
Dispersion	-30%	4.21	<1
Headwater flow	+30%	4.21	<1
Headwater flow	-30%	4.21	<1
Waste Load BOD	+30%	4.21	<1
Waste Load BOD	-30%	4.21	<1
Waste Load DO	+30%	4.21	<1
Waste Load DO	-30%	4.21	<1
Waste Load flow	+30%	4.21	<1
Waste Load flow	-30%	4.21	<1
Waste Load NH3	+30%	4.21	<1
Waste Load NH3	-30%	4.21	<1
Waste Load Organic N	+30%	4.21	<1
Waste Load Organic N	-30%	4.21	<1
NH3 decay rate	+30%	4.19	<1
Organic N decay rate	+30%	4.19	<1
NH3 decay rate	-30%	4.24	1
Organic N decay rate	-30%	4.24	1
BOD decay rate	+-30%	4.14	2
BOD decay rate	-30%	4.28	2
Depth	-30%	4.33	3
Velocity	-30%	4.34	3
SOD (Benthal)	-30%	4.46	6
Initial Temperature	+2˚C	3.94	6
Initial Temperature	-2˚C	4.48	6
SOD (Benthal)	+30%	3.87	8
Velocity	+30%	3.86	8
Depth	+30%	3.82	9
Reaeration	+30%	4.83	15
Reaeration	-30%	3.04	28

7.0 OTHER RELEVANT INFORMATION

This TMDL has been developed to be consistent with the antidegradation policy in the LDEQ water quality standards (LAC 33:IX.1109.A).

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the Federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) List of impaired waters. This information is also utilized in establishing priorities for the LDEQ NPS program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) List. The sampling schedule for the first five-year cycle is shown below. The Mermentau and Vermilion-Teche Basins will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins
1999 – Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors. During 1998, 476 compliance evaluation inspections and 165 compliance sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

8.0 PUBLIC PARTICIPATION

When EPA establishes a TMDL, 40 CFR §130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999 Court Order, this TMDL was prepared under contract to EPA. After submission of this TMDL to the Court, EPA commenced preparation of a notice seeking comments, information, and data from the general and affected public. Comments and additional information were submitted during the public comment period and this Court Ordered TMDL was revised accordingly. Responses to these comments and additional information are included in Appendix L. EPA has transmitted this revised TMDL to the Court and to LDEQ for incorporation into LDEQ's current water quality management plan.

9.0 REFERENCES

EPA. 1985. Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling (Second Edition). Written by G.L. Bowie et. al. EPA/600/3-85/040. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

EPA. 2000. Modified Court Ordered 303(d) List for Louisiana. Downloaded from EPA Region 6 website (www.epa.gov/earth1r6/6wq/ecopro/latmdl/modifiedcourtorderedlist.xls).

FTN. 2000a. Bayou Lacassine Watershed TMDL for Dissolved Oxygen. Prepared for LDEQ by FTN Associates, Ltd., Little Rock, AR: September 2000.

FTN. 2000b. Lake Fausse Pointe and Dauterive Lake TMDL for Dissolved Oxygen and Nutrients. Prepared for LDEQ by FTN Associates, Ltd., Little Rock, AR: September 2000.

LDEQ. 1998a. 1998 305 (b) Appendix C Table. Printed from Louisiana Department of Environment Quality website (www.deq.state.la.us/planning/305b/1998/305b-ctab.htm).

LDEQ. 2000a. Environment Regulatory Code. Part IX. Water Quality Regulations. Chapter 11. Surface Water Quality Standards. § 1123. Numerical Criteria and Designated Uses. Printed from LDEQ website (www.deq.state.la.us/ planning/regs/title33/index.htm).

LDEQ. 2000b. Louisiana TMDL Technical Procedures Manual. Developed by M.G. Waldon and revised by M.G. Waldon, R.K. Duerr, and M.U. Aguillard. Engineering Group 2, Louisiana Department of Environmental Quality, Baton Rouge, LA: September 8, 2000.

LDEQ. 2000c. "Defaults for uncalibrated modeling". Unpublished 1-page document prepared by Engineering Group 2, Louisiana Department of Environmental Quality, Baton Rouge, LA: May 2000.

Lee, F.N., D. Everett, and M. Forbes. 1997. Lowflow Data for USGS Sites through 1993. Report prepared for LDEQ. March 1997.

Smythe, E. deEtte. 1997. Overview of the 1995 Reference Streams. Prepared for Louisiana Department of Environmental Quality, Baton Rouge, LA: August 15, 1997.

USACE. 1998. Master Water Control Plan, Mermentau River Basin, Louisiana. U.S. Army Corps of Engineers, New Orleans District.

USGS. 1971. Drainage Area of Louisiana Streams. Basic Records Report No. 6. Prepared by US Geological Survey in cooperation with Louisiana Department of Transportation and Development Baton Rouge, LA: 1971 (Reprinted 1991).

USGS. 1980. Low-Flow Characteristics of Louisiana Streams. Water Resources Technical Report No. 22. Prepared by US Geological Survey in cooperation with Louisiana Department of Transportation and Development, Baton Rouge, LA.

USGS. 1998. Louisiana GAP Land Use/Land Cover Data. Downloaded from Spatial Data and Metadata Server, National Wetlands Research Center, U.S. Geological Survey. (http://sdms.nwrc.gov/gap/landuse.html).

Wiland, B.L., and K. LeBlanc. 2000. LA-QUAL for Windows User's Manual, Model Version 3.02, Manual Revision B. Wiland Consulting, Inc. and Louisiana Department of Environmental Quality. March 23, 2000.

APPENDICES A THROUGH K ARE AVAILABLE FROM EPA UPON REQUEST

APPENDIX L

Response to Comments

COMMENTS AND RESPONSES
BAYOU PETITE ANSE
TMDLs FOR DO AND NUTRIENTS
April 19, 2002

EPA appreciates all comments concerning these TMDLs. Comments that were received are shown below with EPA responses inserted in a different font.

GENERAL COMMENTS FROM LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY (LDEQ) (some of these comments may not apply to this report):

In view of LDEQ's TMDL development schedule and the rapidly approaching deadline, LDEQ has made a limited review of the TMDLs published by EPA on October 15, 2001. LDEQ expects to make a more detailed review on at least some of these TMDLs after the first of the year. In the future, LDEQ requests that EPA provide hard copies of the TMDLs and Appendices for LDEQ review. Several electronic files required software which is not used by LDEQ thus making it impossible to review some portions of several TMDLs. Hard copies will insure that the complete official document is being reviewed and will eliminate the time required for LDEQ to try to put together the document from electronic files. In general, LDEQ found these TMDLs to be unacceptable, based on inadequate data and not implementable.

Federal Register Notice: Volume 66, Number 199, pages 52403 - 52404 (10/15/2001)

A. Vermilion River Cutoff DO and Nutrients .pdf
B. Bayou Chene DO .pdf
C. Bayou du Portage DO .pdf
D. Bayou Mallet DO, Nutrients and Ammonia .pdf
E. Bayou Petite Anse DO and Nutrients .pdf
F. Bayou Tigre DO and Nutrients .pdf
G. Big Constance Lake and Mermentau Coastal Bays and Gulf Water TMDLs for DO and Nutrients .pdf
H. Charenton Drainage and Navigation Canal and West Cote Blanche Bay TMDLs for DO and Nutrients.pdf
I. Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaises Diversion Channel TMDLs for DO and Nutrients.pdf
J. Dugas Canal DO and Nutrients .pdf
K. Franklin Canal DO and Nutrients .pdf
L. Freshwater Bayou Canal DO and Nutrients .pdf
M. Irish Ditch/Big Bayou DO .pdf

N. Lake Arthur, Grand Lake, and Gulf Intracoastal Waterway TMDLs for DO, Nutrients, and Ammonia .pdf
O. Lake Peigneur DO and Nutrients .pdf
P. New Iberia Southern Drainage Canal DO and Nutrients .pdf
Q. Spanish Lake DO .pdf
R. Tete Bayou DO and Nutrients .pdf
S. Bayou Carron DO and Nutrients .pdf
T. West Atchafalaya Basin Protection Levee Borrow Pit Canal DO.pdf

1. Many of these TMDLs are based on models using historical water quality data gathered at a single location rather than survey data gathered at several sites spaced throughout the waterbody. Hydraulic information used was generally not taken at the same time as the water quality data used. The availability of only one water quality data site is not sufficient justification to simulate the subsegment using a one reach, one element model. Additional reaches and elements must be used to represent the subsegment and additional data must be obtained in order for these TMDLs to be valid. The recommended maximum limits cited in the LAQUAL User's Manual for element width and length have been grossly exceeded in many of the models. The spreadsheet calibration and projection graphs that were provided do not match the plots produced by the LA-QUAL model. Please explain why they do not match. The LAQUAL graphics for a few elements produces a graph that does not represent the model output. It's an anomaly of the graphics routine. The calibrations are inadequate due to the lack of a hydrologic calibration and the paucity of water quality data. The resulting TMDLs are invalid. LDEQ does not accept these TMDLs.

Response: The TMDLs were based on existing data plus information that could be obtained with available resources. Each model was developed using the most appropriate hydraulic information and water quality data that were available. The level of detail at which each subsegment was modeled was consistent with the amount of available data. Although having only one element in a model causes inaccuracies in the LAQUAL graphics, having only one element in a model does NOT cause errors in the tabular output (which is what the graphs in the reports are based on). Although LDEQ typically collects more data for model calibration than what was available for calibration of these models, EPA considers these model calibrations and the resulting TMDLs to be valid.

2. LDEQ does not consider any of these waters to be impaired due to nutrients or ammonia. LDEQ does not consider Vermilion River Cutoff (060803), Mermentau Coastal Bays and Gulf Water (050901), Charenton Drainage and Navigation Canal (060601), West Cote Blanche Bay (061001), Bayou Des Glaises Diversion channel (060207), Grand Lake (070701), Gulf Intracoastal Waterway (050702, Lake Peigneur (060909), New Iberia Southern Drainage Canal (060904) and West Atchafalaya Basin Protection Levee Borrow Pit Canal to be impaired by biochemical oxygen-demanding substances. Many of these waters simply have inappropriate

standards and criteria. The resources spent on developing these TMDLs could have been far more effectively and wisely spent on reviewing, approving, and assisting in the development of appropriate standards and criteria for these waters through the UAA process.

Response: TMDLs were developed for these subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the suspected causes of impairment (organic enrichment/low DO, nutrients, or ammonia) for each subsegment in the EPA Modified Court Ordered 303(d) List.

3. Remove the reference and all references to the unpublished LDEQ document, "Defaults for Uncalibrated Modeling". This is not an acceptable reference and any defaults selected on this basis must be reevaluated and based on acceptable references. Some of the models must be redone because of inappropriately selected defaults. At this time, LDEQ has no plans to revise, complete or publish this document.

Response: The unpublished LDEQ document that is mentioned here was provided to EPA's contractor without any instructions not to use it. The model coefficients listed in that document appear to be reasonable and consistent with values used in other modeling studies in southern Louisiana.

4. The percent reduction of the nonpoint source load must not be reported as an overall average of the individual percent reduction applied to each reach. This approach does not insure that standards will be met in all reaches and will be difficult to implement. In consideration of future implementation plans, LDEQ does not vary the percent reduction required from reach to reach. LDEQ uses a uniform percent reduction within a watershed unless there are unique conditions, such as a general change in landuse, that dictate a further breakdown. These unique conditions must be adequately documented in the report in order to facilitate future implementation plans. Specifying type of land use is helpful in defining nonpoint loading. LDEQ requests a calculation sheet of the NPS reduction percentages and asks that language be added to the report describing the calculation process.

Response: EPA appreciates this comment but believes that an average percent reduction is acceptable. EPA will consider this in future development of TMDLs in Louisiana.

In the lower Mermentau and Vermilion River Basins, much of the nonpoint loading affecting some of these subsegments and adding to their benthic blanket is coming from the tributaries feeding them. Many of the headwater tributaries have recent TMDL's that require dramatic percentage reductions to the nonpoint contributions. By implementing the reductions to nonpoint loads upstream, the current problems in these lower subsegments will be reduced.

Response: EPA recognizes that TMDLs have been developed upstream of several of these subsegments. Implementing upstream reductions in nonpoint loads should require much less reduction of loadings from within these subsegments. The required percent reductions for these subsegments were not intended to be in addition to upstream reductions.

5. The percentage reductions listed were not calculated based on the written procedure described in several TMDLs. These values did not take the MOS into consideration. It is also LDEQ's policy to make a no-man-made load projection run which will estimate the natural background loads. The contractor should include a no-man-made load projection run in each TMDL report.

Response: The percent reductions were calculated by subtracting the projection input value from the calibration input value and then dividing by the calibration input value. This procedure is slightly different than what LDEQ uses but still provides percent reductions that are useful.

6. CBODu and NH3-N were estimated from surrogate parameters rather than actual measured data for most of the TMDLs. Based on the measured data from the last two years of LDEQ water quality surveys, LDEQ objects to the correlation of TOC to CBOD and NH3-N to TKN, unless these correlations are taken from water quality data on the modeled waterbody. Our studies have shown only a moderate correlation between these two parameters within the same waterbody, however when this correlation was attempted across waterbodies extreme variability was seen and the correlation was not judged valid. It is possible that a combination of surrogates will obtain a better correlation, such as TOC along with color, turbidity, pH, etc. LDEQ is currently researching these options.

Response: EPA agrees that it would be ideal to have data collected from the modeled waterbody for relating TOC to CBOD and NH3-N to TKN. However, for these subsegments, there was insufficient data from which these relationships could be developed.

7. LDEQ takes exception to the equating of COD to CBODu in some of the TMDLs. There is no data to support this assumption. No direct correlation has been drawn between these two parameters. The only correlations that have been found are variable and dependant on the type of discharge. LDEQ requests that facilities with only COD limits be removed from the WLA load calculations.

Response: EPA agrees that COD is not an ideal indicator of CBODu. However, EPA believes that most effluents that exert significant COD are likely to exert some oxygen demand in natural waterbodies and therefore the discharges with COD limits should be included in the TMDLs.

8. CBODU and Org-N settling rates were not used. This is not justifiable in areas dominated by agricultural activities and is poor practice for TMDLs on Louisiana waters. The models must be revised to include settling rates.

Response: Without the use of settling rates, all of the pollutant loading remains in the water column where it can consume oxygen. Depending on the model settings for conversion of settled pollutant loading to SOD, the model can be more conservative without settling rates. Other applications of water quality models for TMDLs on southern Louisiana waterbodies have not used settling rates and have been approved by LDEQ.

9. The TMDLs should be for biochemical oxygen-demanding substances instead of DO. DO is an indicator of the impact of biochemical oxygen demanding load, hydrologic modifications, excessive algae blooms, etc.

Response: The TMDLs in Section 5 of each report are already expressed in terms of oxygen demand.

10. Nitrification inhibition option number 2 is valid for Louisiana's waterbodies. Various studies have shown that Louisiana does not have a buildup of NH3-N in its waterbodies. If option 1 was needed for a proper calibration then that should be stated as such.

Response: The nitrification inhibition option was set based on algorithms in other widely used water quality models. Option 1 has been used in other water quality modeling applications for TMDLs on southern Louisiana waterbodies that have been approved by LDEQ.

11. A winter projection model was not developed for most of the TMDLs. Winter projection models must be developed to address seasonality requirements of the Clean Water Act. Where point sources have seasonally variable effluent limitations or such seasonal variations are proposed, a winter projection model is required to show that standards are met year-round.

Response: As discussed in Section 4.2 of each report, summer is the most critical season for meeting the year round standard for DO for this subsegment. Therefore, the summer simulation satisfies the seasonality requirements of the Clean Water Act. Performing additional simulations to evaluate permit limits that are seasonal or hydrograph controlled releases was not required for developing these TMDLs and can be done by LDEQ or by permittees.

12. There was no documentation (LA-QUAL plots) to indicate that the model was calibrated to all hydrologic parameters (i.e. flow, width, depth, time of travel, velocity, chloride balance, etc.). Apparently flow balances were performed, however a flow balance is not a hydrologic calibration. Most of the models must be recalibrated with adequate hydrologic data. Calibration plots for all of the hydrologic parameters must be provided in the appendices.

Response: The values of depth, width, and flow in each model were estimated based upon the most appropriate available information. Hydraulic calibration of each model was not possible due to a lack of data.

13. The calibration and projection plots for dissolved oxygen must be provided in the body of the reports. Additional projection plots for CBODU, NH3-N, and Org-N must be provided in the appendices.

Response: The placement and number of plots in the draft reports are acceptable.

14. The calibration simulation must be used as the baseline for the sensitivity analysis, not the projection simulation. LDEQ requests that all TMDLs be revised in this regard.

Response: The sensitivity analysis can be developed using either the calibration or the projection as a baseline. EPA will consider this in future development of TMDLs in Louisiana.

15. A list of all point source dischargers must be provided in the body of the reports. Only dischargers with flows that reach the named waterbody should be included in the TMDLs.

In several TMDLs, a default 0.001 MGD flow rate was assigned to dischargers where a flow rate was not available. This practice is unacceptable to LDEQ. This default flow rate is extremely low (LDEQ would typically use 0.005 MGD as a minimum) and could strictly limit these dischargers' allowable permit loads when their permits are renewed. Additional research should be done to determine the facility type and anticipated flow rates of these facilities.

Response: The placement of the list of point source dischargers in the draft reports is acceptable. The dischargers with no flow rate information are believed to have very small flow rates representing a very small portion of the total TMDLs. The actual flow rate for each facility can be determined by LDEQ when the facility's permit is being renewed.

16. LDEQ does not agree with the minor point sources loads being subtracted from the NPS load as was done in several of the TMDLs. The pollutant loads being addressed are non-conservative loads. Many of these dischargers are located on small tributaries to the 303(d) waterbody which have recovered prior to entering into that system. Thus they are not contributing to the pollutant loads in the impaired waterbody. LDEQ's current procedure is to add these loads to the WLA portion of the TMDL.

Response: In the reports for which this comment is applicable, the TMDL calculations have been revised so that these loads are added to the WLA portion of the TMDL (same as LDEQ's procedure). For most of the draft reports, the TMDL calculations already used LDEQ's procedure of adding the minor point sources to the modeled loads.

17. Proper justification must be provided when using a nonpoint source margin of safety value other than the typical LDEQ value of 20%.

Response: The nonpoint margin of safety (MOS) was set to 10% based on other TMDLS on southern Louisiana waterbodies that have either been developed by LDEQ or approved by LDEQ. Eleven TMDL reports from LDEQ's website were reviewed to examine the explicit MOS for nonpoint sources. All 11 of these TMDLs were for oxygen demanding substances in the Mermentau or Vermilion-Teche basins. The explicit MOS for nonpoint sources was set to 20% for 2 reports, 10% for 3 reports, and 0% for 6 reports. Therefore, the value of 10% was considered to be a typical value that did not need special justification.

18. LDEQ has major concerns relating to the use of a one dimensional steady state model in coastal bays, lakes and estuaries. These systems are typically dominated by tides and winds and do not behave like riverine systems. LAQUAL can be used to simulate estuarine systems with riverine characteristics and some tidal influences; however to use it in these applications exceeds the model's recommended input limitations and appears to produce a meaningless output. Also the systems' unique hydrological characteristics do not adapt well to LAQUAL's one-dimensional capabilities. A multi-dimensional model such as WASP should be used for these waters. While a dynamic model would be preferred, a steady-state multi-dimensional model would be acceptable if it adequately addresses tidal influences. LDEQ objects to the use of LAQUAL in determining TMDLs for coastal bays, lakes and estuaries.

Response: A one dimensional steady state model such as LAQUAL was considered to be appropriate for all of these subsegments based on the amount of data that were available. Proper application of a multi-dimensional model or a dynamic model would require much more data and is simply not necessary for these waterbodies. For large, wide waterbodies, WASP will yield the same results as LAQUAL if the configuration of elements and model coefficients are the same between the two models.

19. The report uses the term synoptic survey multiple times. Please describe in detail what area this survey encompassed as well as site locations and what parameters were tested. Also, the raw data from this survey must be included in the appendices as support for the model inputs and calculations.

Response: A description of the synoptic survey and a summary of the data have been added to the appendices for each report in which those data are used.

20. In many of the calibration models the average water quality data from several LDEQ stations were used. It has been LDEQ's experience that a better calibration can be accomplished by using a single day's water quality and flow data. The additional daily values could then be used to perform multiple verifications of the model parameters before proceeding to the projection

stage. The flow data should be collected at the same time as the water quality data in order for the model to be valid.

Response: The models were calibrated to averages over multiple sampling events to minimize the effects of any single field measurement that might be of questionable quality or indicative of conditions that may have lasted only a very short time. For large systems with long residence times, using only a single snapshot of water quality data is often not representative of steady state conditions for that system.

21. Grammatical errors and misspelled words were found in these reports.

Response: The reports have been reviewed for grammar and spelling.

22. There does not appear to be any significant anthropogenic source of nutrients from agriculture, silviculture, aquaculture or urban runoff in many of these subsegments. Therefore, any occurrence of low DO is almost certainly natural. As a result, a UAA for the area is necessary to reset the DO standard. A TMDL is unwarranted for these subsegments,and LDEQ takes exception to EPA generating TMDLs which are impossible to implement.

Response: EPA is required to generate these TMDLs based on the Modified Court Ordered 303(d) List and the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7.

23. LDEQ's nutrient standard is based on total phosphorus (TP) and total nitrogen (TN), not total inorganic nitrogen (TIN). Since phosphorus is not the limiting constituent in Louisiana, the nutrient allocations must be in terms of TN and only TN.

Response: LDEQ's nutrient standard (LAC 33:IX.1113.B.8) does not specify that nitrogen to phosphorus ratios should be based on total nitrogen. However, EPA will consider this in future development of TMDLs in Louisiana.

In the coastal areas, the nitrogen to phosphorus ratio used was based on freshwater streams and is not applicable to brackish Gulf waters. LDEQ takes exception to the calculation of a TMDL based on TN/TP ratios derived from waterbodies other than the modeled waterbody. It is LDEQ's experience that the natural allowable TN/TP ratio is waterbody-specific and can vary dramatically between streams.

Response: EPA agrees that it would be ideal to have a large database of nitrogen to phosphorus ratios for each waterbody. However, because these subsegments have only limited nutrient data, the previously developed nitrogen to phosphorus ratio that was used in the draft reports is considered acceptable.

LDEQ has not adopted the EPA recommended ammonia criteria (1999) and takes exception to its use in this TMDL. In general, LDEQ does not accept EPA's use of national guidance for TMDL endpoints. The nationally recommended criteria do not consider regional or site-specific conditions or species and may be inappropriately over protective or under protective. No ammonia nitrogen toxicity has been demonstrated or documented in any of the waterbodies in these TMDLs. The general criteria (in particular, LAC 33:IX.1113.B.5) require state waters be free from the effects of toxic substances.

Response: Ammonia TMDLs were developed for two subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the fact that the Modified Court Ordered 303(d) List included ammonia as a suspected cause of impairment for those two subsegments. National guidance for ammonia toxicity was used in the absence of any numerical state water quality standards for ammonia.

24. The implicit margin-of-safety must not be quantified.

Response: The text of the reports has been revised to eliminate any quantification of the implicit margin of safety.

25. EXECUTIVE SUMMARIES: Add summary tables of the WLAs, LAs, and TMDLs showing the allocations and margins of safety.

Response: The summary tables of the WLAs, LAs, and TMDLs can be easily found in Section 5 of each report and do not need to be repeated in the executive summary.

26. Temperature Correction of Kinetics: A temperature correction factor was set for reaeration. It is LDEQ's standard practice to allow LAQUAL to calculate this factor. There is more guidance on this in the LAQUAL User's Manual.

Response: The temperature correction factor was reaeration was set to the value of 1.024 based on guidance in Section 3.3.8 of the LTP.

27. Water Quality Kinetics: The Louisiana reaeration equation was used on reaches that are outside the maximum depth that it was designed for. A more appropriate reaeration equation must be selected.

Response: The Louisiana equation yielded reaeration coefficients that appeared more reasonable than coefficients from other equations.

28. Water Quality standards and designated uses tables did not include the BAC (bacterial criteria) values.

Response: The water quality standards for bacteria are not relevant for these TMDLs.

29. The statement was made in the Initial Conditions paragraphs in several of the reports that temperature was specified because the temperature was not being simulated. The section then states, "For constituents not being simulated, the initial concentrations were set to zero …". Initial conditions provide a starting point for the iterative solution of modeled constituents. They also provide values for constituents that are needed as input but are not being simulated.

Response: EPA appreciates this comment.

30. Several reports describe the benthic ammonia source rate as a calibration parameter; however a review of the data type 13 calibration input section indicates a value of zero for this parameter, in all reaches.

Response: The benthic ammonia source rate was used as a calibration parameter; the value of that parameter that provided the best fit between predicted and observed values was zero.

31. Calibration, and Projection, Data type 27: A salinity value was set to zero in the boundary conditions for both the calibration and the projection models in several of the TMDLs. With this value set to zero the model will automatically adjust the values of the lowest reach's elements to the value set in the boundary conditions. Since most of the models were one-reach, one-element models, the model automatically set the element salinity to zero, thus calculating an inaccurate value for the DO saturation.

Response: The only models where salinity was set to zero in the downstream boundary conditions were those models where salinity was not considered high enough to have a significant impact on DO saturation.

32. It is not LDEQ's standard procedure to use a zero headwater flow. You may not have input a headwater flow, but the model did. Without a headwater flow the model would have crashed and not run. The model's programming allows for a 0.0000001 cms flow rate when the modeler has not input a headwater flow.

Response: Only two simulations (calibrations for Spanish Lake and Big Constance Lake) used a zero headwater flow. For all practical purposes, 0.0000001 m3/sec is the same as zero flow.

33. Hydraulics and Dispersion: The use of constant widths and depths requires proper justification.

Response: The widths and depths were justified in Section 3 of each report.

34. Several reports state that algae were not simulated because algae did not appear to have

significant impacts. What was the evidence for this statement? Did the contractor have any Chlorophyll a measurements?

Response: This statement was based on general knowledge of the Mermentau and Vermilion-Teche basins as well as a limited amount of diurnal DO data collected in these basins.

SPECIFIC COMMENTS FROM LDEQ FOR BAYOU PETITE ANSE:

1. GENERAL: The drainage area of Bayou Parc Perdue and the Bayou Des Cannes flow to drainage area ratio were used to estimate the headwater flow for Bayou Petite Anse. The report states that the Bayou Petite Anse model starts at the confluence of Bayou Parc Perdue and Segura Branch Canal. There was no discussion of the drainage area of the Segura Branch Canal and the flow associated with it. This must be addressed in the report. The calibration model must be revised if necessary.

Response: The drainage area used for the headwater flow calculations was the total drainage area at that point along the stream.

2. GENERAL: The spreadsheet calibration and projection graphs that were provided do not match the plots produced by the LA-QUAL model. Please explain why they do not match. Where do calibration and projection model results in the spreadsheet graphs come from? This was probably caused by a one-element reach's distorting the graphs.

Response: See response to comment 1 in LDEQ General Comments above.

3. Page 5-2, Table 5.2: Explain where the NO_2^-+NO_3^- loads came from.

Response: The nitrate+nitrite loads were calculated from loadings of nitrate+nitrite. These loads are from inflows to the system, including headwaters, tributaries, and point sources.

GENERAL COMMENTS FROM LOUISIANA STATE UNIVERSITY AG CENTER (some of these comments may not apply to this report):

Through this letter the Louisiana State University AgCenter would like to submit official comments on TMDLs for dissolved oxygen and nutrients associated allocations for waterbodies in:

- Vermilion River Cutoff

- Bayou Chene
- Bayou Petite Anse
- Bayou Tigre
- Big Constance Lake and Mermentau Coastal Bays and Gulf Water
- Charenton Drainage and Navigation Canal and West Cote Blanche Bay
- Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaises Diversion Channel
- Dugas Canal
- Franklin Canal
- Freshwater Bayou Canal
- Irish Ditch/Big Bayou
- Lake Arthur, Grand Lake, and Gulf Intracoastal Waterway
- Lake Peigneur
- New Iberia Southern Drainage Canal
- Spanish Lake
- Tete Bayou
- Bayou Carron
- West Atchafalaya Basin Protection Levee Borrow Pit Canal

The number of different TMDLs sent out for comment at the same time may overwhelm the public's ability to comment. With only 30 days to prepare and submit comments it is impossible for a qualified faculty member to review the supporting data in depth and attend to his(her) official responsibilities. I realize that the agency is under time constraints on completing these, but I earnestly request that more time per proposed TMDL be given in the future.

We must make several other general comments and objections that apply to most of the proposed TMDLs. In many cases the data used to calibrate the models for the stream segments was collected in the fall of 2000 near the end of a three year drought. Historic low flows were often commented on in the text of the TMDL. Low flows result in a biased estimate of the natural ability of the stream to reaerate and cleanse itself of pollutants. Low flows also enable the benthic blanket to accumulate and remain in place undisturbed causing overstatement of the benthic oxygen demand and the SOD which were in many cases the primary oxygen demand loads in the stream. While it is true that the high flows that come from storm events carry more organic and sediment loads into the stream, the high flow rates also scour material from the bottoms and move it on to a final deposit at the stream terminus. It was thus that most of Louisiana and all of our coastal areas were built. Prolonged drought conditions do not allow this natural cleansing to occur. Thus it is our belief that the part of the oxygen demand load attributed to benthic and sediments is overstated and that new data must be collected during normal rainfall conditions and the models re-calibrated.

Response: The Louisiana water quality standards are applicable during all flow conditions greater than the 7Q10. Because 7Q10 flow is frequently the most critical condition for maintaining the DO standard, it is desirable to collect field data for model calibration during times when the hydrology is as close as possible to 7Q10 conditions. It is believed that the flow conditions for these waterbodies may have been near 7Q10 conditions, but probably not lower than 7Q10 flows. Therefore, the summer-fall 1998 data is desirable for model calibration.

In far too many of the proposed TMDLs the phrase *"an intensive field survey was not conducted for the study area due to schedule and budget limitations"* was found. If municipalities, agriculture, and business entities are to be asked to make large commitments of funds, time and effort to resolve our water quality problems they deserve to have the benefit of a serious study of the problem. We request that all of the proposed TMDLs that contain this statement have this problem corrected and that TMDLs be prepared based on complete studies.

Response: There is no requirement for collecting a certain amount of data to make a TMDL valid. If additional data are collected in the future by LDEQ, other agencies, or local stakeholders, then those data can be evaluated at the time and the implementation of the TMDL can be altered as necessary. As outlined in the 1991 EPA document titled "Guidance for Water Quality-Based Decisions: The TMDL Process", developing and implementing TMDLs is a process and not a one-time event.

In several of the proposed TMDLs data was used that is 9 or 10 years old from studies on point source discharges. While the data is probably high quality it assumes that no change in the plant or its load have occurred in the last decade. This assumption may not be defensible. In the TMDLs where a treatment plant was included in the model the margin of error was calculated by using 125% of the design capacity. This assumes a plant will perform at the same level when it is operated in excess of its design load. This assumption is also questionable.

Response: For several subsegments, old data sets were used for calibration because they provided more extensive data than newer data sets. However, all of the projection runs simulated point source discharges based on the most recent information available. Simulating point source discharges at 125% of design flow is simply a way of incorporating an explicit margin of safety and does not assume that the facility can actually treat that much wastewater.

The standard for dissolved oxygen (DO) was held at 5 mg/L in some steams on a year round basis, even if it received or discharged into a stream with 5 mg/L winter and 2 or 3 mg/l summer standards. Other streams had a year DO oxygen standard of 4 mg/L. We strongly suggest that a review be made of the DO standards for all of the streams in south Louisiana that are shallow, sluggish, and subject to tidal influence and that uniform standards be set. In view of the remarks that achieving a DO of 5 mg/L was impossible in some of the streams that had little loading from human activities, we believe that the summer standard of 2 mg/L is much more applicable to these streams.

Response: The TMDLs are required to be developed for the existing DO standard, which is 5 mg/L year round for many of these subsegments. If the DO standard is revised in the future for any of these subsegments, the TMDL and implementation can be altered as necessary as part of the TMDL process.

Many of these TMDLs were drafted by an out of state contractor and do not appear to be as well researched as those drafted by LDEQ. Very little data was included in the contractor drafted TMDLs summaries as compared to the ones prepared by or in conjunction with LDEQ. Additionally, the bulk of the text appeared to be standard wording in all documents with short relevant inserts. We would request that if outside contractors be used in future TMDL assessments that they be held to the same standard of information inclusion that LDEQ provides. Stream diagrams and maps are often needed when reviewing descriptive text on stream location, tributary insert, and exact location.

Response: These TMDLs contain all the required components of a TMDL and the level of detail is considered acceptable. Because these TMDLs could not be funded at the same level as most of LDEQ's DO TMDLs, the analysis and documentation was not as extensive as most of LDEQ's DO TMDLs. However, some of the information that was mentioned in the comment (stream diagrams and maps) was included in the reports, but they were placed in the appendices (which were available from EPA upon request).

SPECIFIC COMMENTS FROM LSU AG CENTER FOR BAYOU PETITE ANSE:

NPS reductions of 40-70% for the different reaches of the stream will be achievable. In this stream the SOD appears to be a major factor in the low DO and as previously stated, collection of data after a period of normal rainfall may reduce the required NPS reductions to an attainable level.

Response: EPA appreciates this comment. See responses to comments above concerning calibration of the model using data collected during hot, dry conditions.